

**US ENVIRONMENTAL PROTECTION AGENCY  
REGION IX**



**REVISED  
Statement of Basis and Ambient Air Quality Impact  
Report**

**For a Clean Air Act  
Prevention of Significant Deterioration Permit**

**November 29, 2007**



**Big West of California, LLC  
Bakersfield Refinery - Clean Fuels Project**

**PSD Permit # SJ-05-01 (06-029-S0033-1.0)**



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

**Table of Contents**

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**Acronyms and Abbreviations**

**Executive Summary**

<b>1. Purpose of This Document.....</b>	<b>- 1 -</b>
<b>2. Applicant .....</b>	<b>- 1 -</b>
<b>3. Project Location .....</b>	<b>- 1 -</b>
<b>4. Project Description.....</b>	<b>- 2 -</b>
<b>5. Emissions from the Project .....</b>	<b>- 6 -</b>
<b>6. Applicability of Prevention of Significant Deterioration Regulations ..</b>	<b>- 6 -</b>
<b>7. Best Available Control Technology .....</b>	<b>- 8 -</b>
7.1.FCCU .....	- 10 -
7.2.SWAATS Unit .....	- 19 -
7.3.Process Heaters .....	- 23 -
7.4.FCCU Startup Air Heater .....	- 32 -
7.5. Multipoint Ground Flare .....	- 34 -
7.6.Emergency Diesel Firewater Pump Engines .....	- 41 -
7.7.Cooling Towers.....	- 43 -
<b>8. Air Quality Impacts.....</b>	<b>- 44 -</b>
8.1.Ambient Data Requirements and Significant Impact Levels.....	- 45 -
8.2.Dispersion Modeling Analysis.....	- 45 -
8.3.Class I AQRV Impact Analysis .....	- 47 -
<b>9. Additional Impact Analysis.....</b>	<b>- 52 -</b>
9.1.Growth Analysis .....	- 52 -
9.2.Vegetation Analysis.....	- 52 -
9.3.Visibility Impairment Analysis.....	- 53 -
<b>10.Endangered Species Act .....</b>	<b>- 55 -</b>
<b>11.Conclusion and Proposed Action .....</b>	<b>- 55 -</b>



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

**Acronyms and Abbreviations**

AQRV	Air Quality Related Value
ARB	California Air Resources Board
ATS	Ammonium Thiosulfate Solution
BA	Biological Assessment
BACT	Best Achievable Control Technology
BO	Biological Opinion
BPD	Barrels per Day
BPIP	Building Profile Input Program
BTU	British Thermal Unit
CAA	Clean Air Act
CFP	Clean Fuels Project
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
DAT	Deposition Analysis Thresholds
EPA	Environmental Protection Agency
ESA	Endangered Species Act
E/U	Emission Unit
<sup>0</sup> F	Degrees Fahrenheit
FCCU	Fluid Catalytic Cracking Unit
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FLM	Federal Land Manager
FWS	(US) Fish and Wildlife Service
g/bhp-hr	grams per brake horsepower hour
GEP	Good Engineering Practice
H <sub>2</sub> S	Hydrogen Sulfide
HGU <sub>2</sub>	Hydrogen Unit
hr	Hour
ISCST3	Industrial Source Complex Short-Term Model
Kg/ha/hr	kilogram per hectare per hour
LAER	Lowest Achievable Emission Rate
lb	Pound
LPG	Liquified Petroleum Gas
MMBTU	Million British Thermal Units
MMSCFD	50 million standard cubic feet per day
MSA	Metropolitan Statistical Area
N	Elemental Nitrogen
NAAQS	National Ambient Air Quality Standard
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Nitrogen Oxides
NSPS	New Source Performance Standard
NSR	New Source Review
O <sub>2</sub>	Oxygen

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

PM	Particulate Matter
PM2.5	Particulate Matter 2.5 microns in diameter or less
PM10	Particulate Matter 10 microns in diameter or less
ppm	Parts per Million
ppmvd	Parts per Million by Volume, Dry Basis
ppmv	Parts per Million by Volume
PSD	Prevention of Significant Deterioration
RBLC	RACT/BACT/LAER Clearinghouse
S	Elemental Sulfur
SCR	Selective Catalytic Reduction
SJVAPCD	San Joaquin Valley Air Pollution Control District
SNCR	Selective Non-Catalytic Reduction
SO <sub>2</sub>	Sulfur Dioxide
SO <sub>x</sub>	Sulfur Oxides
SWAATS	Sour Water Ammonia to Ammonium Thiosulfate Unit
tpy	tons per year
ug/m3	micrograms per cubic meter
USEPAUS	Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USNPS	US National Park Service
VGO-HDS	Vacuum Gas Oil Hydro-De-Sulfurization Unit
VOC	Volatile Organic Compounds
WA	Wilderness Area
WBAN	Weather Bureau Army Navy

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

## **Executive Summary**

Big West of California, LLC has requested approval to construct a Clean Fuels Project at its Bakersfield refinery. The Clean Fuels Project (CFP) will allow the conversion of intermediate products into gasoline and diesel fuel that meets California Air Resources Board (ARB) gasoline and diesel fuel specifications. These intermediates are currently being exported to other refineries for final processing. We believe that the proposed Clean Air Act Prevention of Significant Deterioration (PSD) permit is consistent with the requirements of our PSD permitting program for the following reasons:

- The proposed permit requires Best Available Control Technology (BACT) for Nitrogen Dioxide (NO<sub>2</sub> - referred to throughout this document as Nitrogen Oxides, or NO<sub>x</sub>), Carbon Monoxide (CO), Sulfur Dioxide (SO<sub>2</sub>), and Particulate Matter (PM);
- We have determined that the proposed emission limits will protect Clean Air Act air quality standards for NO<sub>x</sub>, CO, and SO<sub>2</sub>; No such standards exist for PM;
- We have assessed other potential impacts, such as impacts on soils and vegetation, and assessed potential impacts on air quality, visibility, and deposition in Class I areas given special protection under the Clean Air Act;
- We are consulting with the Fish and Wildlife Service under Section 7 of the Endangered Species Act to ensure that the proposed project does not jeopardize any endangered or threatened species (including the San Joaquin kit fox), or result in the destruction or adverse modification of such species' designated critical habitat.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

## **1. Purpose of This Document**

This document serves as the Statement of Basis and Ambient Air Quality Impact Report for a proposed Prevention of Significant Deterioration (PSD) permit for the Clean Fuels Project at the Big West of California, LLC Bakersfield Refinery. This document describes the legal and factual rationale for the proposed permit, including requirements under the PSD regulations at 40 CFR §52.21.

This document also serves as the fact sheet to meet the requirements of Part 40 of the Code of Federal Regulations (CFR) sections 124.7 and 124.8.

## **2. Applicant**

Big West of California, LLC  
A wholly-owned subsidiary of Flying J, Inc.

Mailing address:  
P.O. Box 1132  
Bakersfield, CA 93302

## **3. Project Location**

Big West of California, LLC (Big West) recently purchased the Bakersfield refinery from Shell Oil Company. The Bakersfield refinery is located at 6451 Rosedale Highway about 2.5 miles northwest of the City of Bakersfield (zoned M-3—heavy industry), in the southernmost portion of the San Joaquin Valley Air Basin.

The Bakersfield refinery is divided into three areas: Areas 1 and 2 (which are contiguous), and Area 3 (which is located at 3663 Gibson Street). Areas 1 and 2 are bound by Mohawk Street to the east, Rosedale Highway to the north, Wedding Lane to the west, and Kern River to the south. Only Areas 1 and 2 will be modified as part of the Clean Fuels Project.

The map on the following page shows the approximate location for the Clean Fuels Project.



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**



#### **4. Project Description**

Big West is proposing to construct and operate additional processing units within the existing refinery to increase production of gasoline and diesel fuel that meets California Air Resources Board (ARB) gasoline and diesel fuel specifications. The addition of these units and associated modifications is referred to as the Clean Fuels Project (CFP). Once the CFP is complete, the amount of intermediate petroleum products being exported will be significantly reduced as compared to historical operations; total crude throughput will remain at 70,000 barrels per day (BPD).

Existing refinery process units include crude distillation, delayed coking, hydrocracking, and catalytic reforming. In addition, the refinery includes a number of ancillary and support facilities including steam boilers, process heaters, cooling towers, storage tanks, and interconnecting pipelines. There is also a terminal with both truck and rail loading facilities. The Bakersfield refinery currently produces the following products and intermediates:

- Gas oils (25,000 BPD);
- Gasoline (21,800 BPD);

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

- Diesel fuel (20,300 BPD);
- Fuel gas; and
- Petroleum coke.

The CFP will add the following new process units, with the following capacities:

- Vacuum Gas Oil Hydro-De-Sulfurization Unit (VGO-HDS): 30,000 BPD;
- Fluid Catalytic Cracking Unit (FCCU): 30,000 BPD;
- Liquefied Petroleum Gas (LPG) Merox Treating Unit (Merox unit): 13,500 BPD;
- Alkylation Unit (Alky unit): 13,500 BPD;
- Hydrogen Unit (HGU2): 50 million standard cubic feet per day (MMSCFD);
- Sour Water Ammonia to Ammonium ThioSulfate (SWAATS) unit: 1,200 BPD.

Other new emission units to be regulated by this permit include the following:

- Four new process heaters (two VGO-HDS heaters, one HGU2 heater, and one Alky unit heater)
- One new ground flare, equipped with a flare gas recovery system
- Two or three new emergency firewater pumps driven by diesel engines
- Two new cooling towers (one dedicated to the Alky unit, and another for the remaining cooling water needs)

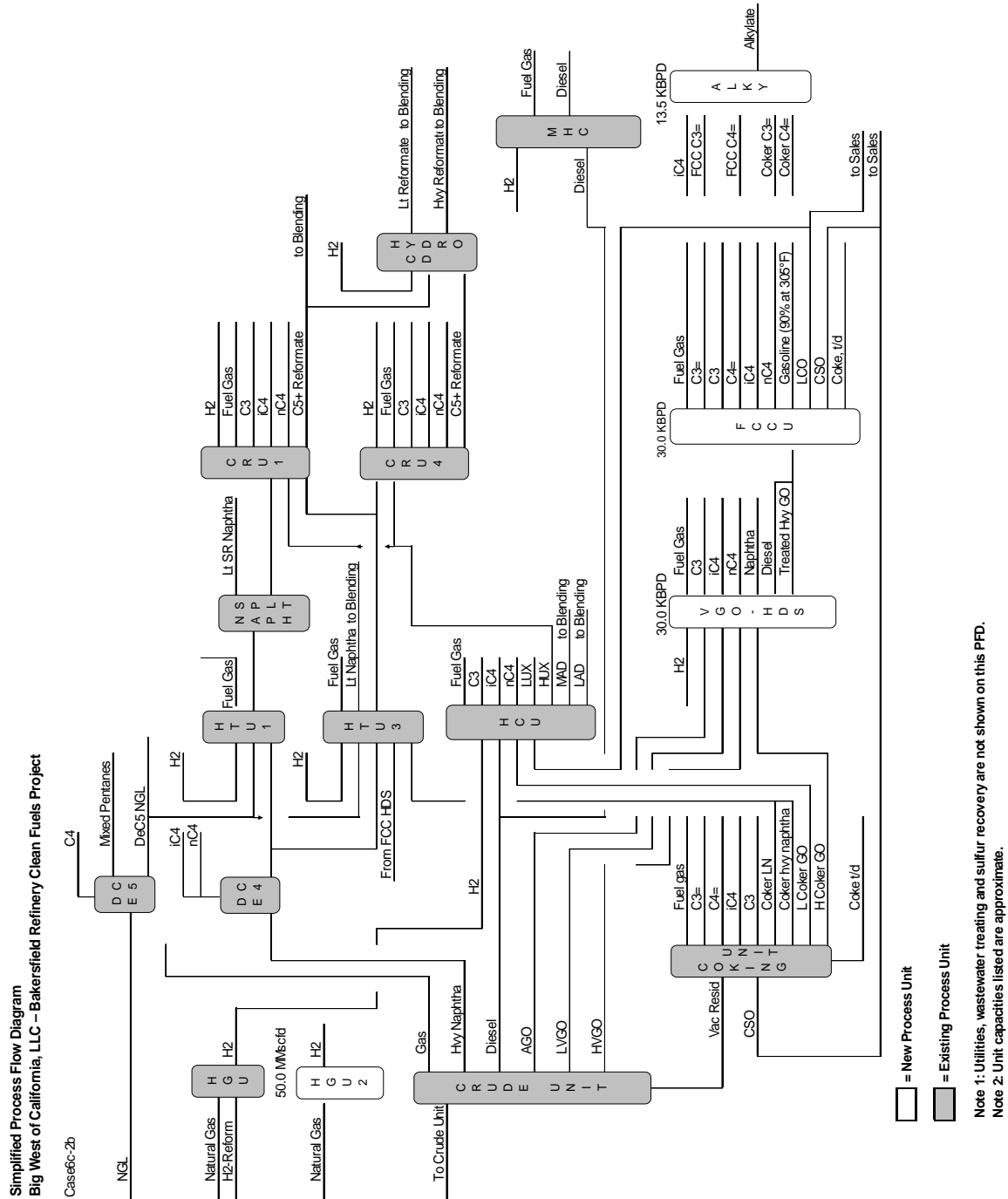
Other changes that will be made as part of this project but which will not result in increased emissions of NO<sub>x</sub>, SO<sub>x</sub>, CO, or PM include:

- A new sour water stripper to handle the additional sour water coming from the new VGO-HDS and FCCU
- Some new loading facilities at the Refinery and the adjacent Sales Terminal will be modified to streamline increased gasoline and diesel production.
- Three existing storage tanks will be modified.
- A new amine treatment unit will be constructed.
- A new wastewater treatment facility.
- The only existing process unit within the Bakersfield refinery that will be modified as part of the CFP is the Mild Hydrocracker. The Mild Hydrocracker unit itself will be modified to allow for additional catalyst in the process unit and allow for processing of distillate from the crude unit. However, no modification will be made to the associated heaters.
- A new 250,000 barrel floating roof crude storage tank will be constructed.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

The diagram below is a simplified process flow diagram.



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

The air pollution control equipment and techniques at the plant will consist of the following:

- A combination of a low NO<sub>x</sub> regenerator design and selective catalytic reduction (SCR) for the FCCU to control NO<sub>x</sub> emissions to 20 parts per million by volume, dry basis (ppmvd), corrected to 0 percent oxygen (% O<sub>2</sub>), on a 365-day rolling average, and to 40 ppmvd, corrected to 0% O<sub>2</sub>, on a 7-day rolling average.
- SO<sub>2</sub>-reducing catalyst additives in the FCCU to limit SO<sub>2</sub> emissions to 20 ppmvd, corrected to 0% O<sub>2</sub>, on a 365-day rolling average, and to 50 ppmvd, corrected to 0% O<sub>2</sub>, on a 7-day rolling average.
- An FCCU regenerator design that employs full burn combustion technology, designed to ensure nearly complete oxidation of CO to CO<sub>2</sub> in the regenerator exhaust, to limit CO emissions to 50 ppmvd, corrected to 0% O<sub>2</sub>, on a rolling 365-day average.
- Oxidation catalyst added to the FCCU to control CO emissions during each startup event.
- A high efficiency particulate (Pall) filter to limit PM emissions to 0.3 lb/1000 lb of coke burned.
- A combination of low-NO<sub>x</sub> burners and SCR on the Alky unit heater and the HGU2 heater to control NO<sub>x</sub> emissions to 5 ppmvd, corrected to 3% oxygen, on a 15-minute average.
- Low NO<sub>x</sub> burners on the two VGO-HDS heaters subject to BACT to control NO<sub>x</sub> emissions to 20 ppmvd, corrected to 3% oxygen, on a 3-hour rolling average.
- The SWAATS unit will be a new process unit designed for sulfur recovery, with a vendor guarantee of 30 ppmvd SO<sub>2</sub> emissions, corrected to 0% oxygen, on a 3-hour average.
- A multipoint ground flare equipped with a flare gas recovery system.
- Emergency firewater pumps driven by Tier 2 or Tier 3 diesel engines.
- High Efficiency Drift Eliminators on the cooling towers to limit PM emissions.
- The use of a safer, modified hydrogen fluoride alkylation process (UOP's "Alkad").
- The Applicant will treat the refinery fuel gas to achieve a limit of 40 ppmv total reduced sulfur, as H<sub>2</sub>S (4-hour rolling average) and 25 ppm H<sub>2</sub>S (on an annual average).

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

## **5. Emissions from the Project**

Pollutant emission rates from the proposed project have been estimated from project design criteria, proposed BACT limits, and emission factors. The first table below displays the estimated net emission increases of Criteria PSD pollutants from the Clean Fuels Project, which will be regulated by this PSD permit. The second table below displays the estimated net emission increases of non-attainment New Source Review (NSR) pollutants from the Clean Fuels Project, which will be regulated by a non-attainment NSR permit to be issued by the San Joaquin Valley Air Pollution Control District. For further discussion of PSD and NSR permitting, see Section 6 below.

<b>PSD Pollutant (Criteria)</b>	<b>Emissions (tpy)</b>
Carbon Monoxide (CO)	166.44
Nitrogen Oxides (NO <sub>x</sub> )	83.2
Sulfur Dioxide (SO <sub>2</sub> )	84.9
Particulate Matter (PM)*	58.9

<b>NSR Pollutant</b>	<b>Emissions (tpy)</b>
Particulate Matter (PM <sub>10</sub> )	58.9
Volatile Organic Compounds (VOC)	102.5

\* All particulate matter emitted will be PM-10 or less

Please note that the emissions data provided above differs from the data provided in the original application as well as subsequent application amendments due to continuous updates to the proposed BACT limits based on new permits that are issued to other refineries across the country. Lower BACT limits result in lower annual emissions.

## **6. Applicability of Prevention of Significant Deterioration Regulations**

The Clean Air Act requires EPA to set National Ambient Air Quality Standards for six common air pollutants. These commonly found air pollutants are known as "criteria pollutants" and are found all over the United States. They are particulate matter (PM-10 and PM-2.5), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. These pollutants can harm your health and the

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

environment, and cause property damage. EPA has established for each criteria pollutant a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards, or “NAAQS.”

Areas that meet the NAAQS are classified as being in “attainment” of the standards. Areas that do not meet the NAAQS are classified as being “non-attainment.” A single area can be attainment for some criteria pollutants and non-attainment for others.

New and modified sources that will emit “attainment” pollutants above established significance levels are subject to the Prevention of Significant Deterioration (PSD) regulations and must obtain a PSD permit; EPA has the responsibility for issuing PSD permits in the San Joaquin Valley. New and modified sources that will emit “non-attainment” pollutants above established significance levels are subject to non-attainment New Source Review (NSR) permitting; the San Joaquin Valley Air Pollution Control District has responsibility for issuing NSR permits in the San Joaquin Valley.

San Joaquin Valley, where the Big West refinery is located, is classified as an attainment area for NO<sub>2</sub>, SO<sub>2</sub>, and CO. The proposed project exceeds the PSD significance thresholds for these pollutants of 40 tpy, 40 tpy, and 100 tpy, respectively; therefore, the Clean Fuels Project is subject to Prevention of Significant Deterioration (PSD) permitting for these three criteria pollutants and is considered a major modification. Lead will not be emitted in amounts above the significance threshold therefore PSD will not apply to this criteria pollutant.

The PSD regulations also apply to emissions of non-criteria pollutants (PM\*, sulfuric acid mist, reduced sulfur compounds, and municipal waste combustor pollutants) emitted in amounts above established significance thresholds. With the exception of PM, emissions of these non-criteria PSD pollutants from the CFP will be far below the significance thresholds. Therefore, PSD is not triggered for these pollutants. The significance threshold for PM is 25 tons per year. As shown in the table in Section 5 above, the potential to emit PM from this project is 58.9 tons per year; therefore, the Clean Fuels Project is subject to Prevention of Significant Deterioration (PSD) permitting for PM, in addition to criteria pollutants NO<sub>2</sub>, SO<sub>2</sub>, and CO.

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\* Total particulate (PM) is a non-criteria pollutant because there are no NAAQS for PM; the NAAQS for PM-10 has replaced the old NAAQS for PM.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

San Joaquin Valley is classified as a non-attainment area for ozone; therefore, the Clean Fuels Project is subject to non-attainment New Source Review (NSR) for VOC (an ozone precursor). The San Joaquin Valley is also designated as non-attainment for fine particulate matter with aerodynamic diameter less than 2.5 micrometers (PM<sub>2.5</sub>) and is subject to non-attainment NSR for PM<sub>2.5</sub>. On October 17, 2006, EPA determined that San Joaquin Valley had attained the NAAQS for PM<sub>10</sub> based on monitoring data from 2003-2005. However, until the State submits, and EPA approves, a PM<sub>10</sub> maintenance plan and a request for redesignation to attainment, the San Joaquin Valley will be classified as a serious PM<sub>10</sub> non-attainment area. Therefore, the Clean Fuels Project is also subject to non-attainment NSR for PM<sub>10</sub>. As noted above, San Joaquin Valley Air Pollution Control District (SJVAPCD or the District) is the local permitting authority responsible for non-attainment NSR permitting. SJVAPCD will also be proposing a Clean Air Act Title V Operating Permit coincidentally with the NSR permit. The combined permit will be called a Certificate of Conformity.

## **7. Best Available Control Technology**

Section 169(3) of the Clean Air Act (CAA) defines BACT as follows:

The term "best available control technology" means an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under the Clean Air Act emitted from or which results from any major emitting facility. The permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, makes a BACT determination through application of processes and available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of each such pollutant. In no event shall application of BACT result in emissions of any pollutant which will exceed the emissions allowed by any applicable standard established pursuant to section 7411 (NSPS) or 7412 (NESHAP) of the Clean Air Act, or any State Implementation Plan.

For attainment pollutants being regulated in a PSD permit, EPA evaluates emissions control requirements through a "top-down" BACT determination, which is described in EPA's New Source Review Workshop Manual, Draft October 1990 ("PSD Manual"). In brief, the top-down process requires that all available control technologies be ranked in descending order of control effectiveness. The PSD applicant first examines the most stringent technology. That technology is established as BACT unless it is demonstrated that technical considerations, or energy, environmental, or economic impacts justify a

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

conclusion that the most stringent technology is not achievable for the case at hand. If the most stringent technology is eliminated, then the next most stringent option is evaluated until BACT is determined. The top-down BACT analysis is a case-by-case exercise for the particular source under evaluation. In summary, the five steps involved in a top-down BACT evaluation are:

1. Identify all available control options with practical potential for application to the specific emission unit for the regulated pollutant under evaluation;
2. Eliminate technically infeasible technology options;
3. Rank remaining control technologies by control effectiveness;
4. Evaluate the most effective control alternative and document results; if top option is not selected as BACT, evaluate next most effective control option; and
5. Select BACT, which will be the most stringent technology not rejected based on technical, energy, environmental, and economic considerations.

BACT is required for NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM for the following emission units: the FCCU, the SWAATS unit, refinery process heaters, the FCCU startup air heater, the flare, emergency diesel firewater pump engines, and the two cooling towers, because these units have the potential to emit air pollutants for which PSD has been triggered. Unless otherwise noted below, in making a final proposed determination of BACT for the above pollutants and emission units, we consulted Big West's application materials, as well as EPA's RACT/BACT/LAER Clearinghouse (RBLC); California Air Resources Board State-wide BACT Clearinghouse; EPA's existing and proposed New Source Performance Standards for Petroleum Refineries, NSPS Subparts J and Ja; and EPA's Global Refinery Consent Decrees.



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

## **7.1. FCCU**

Following removal of contaminants at the proposed new Hydro-De-Sulfurization unit, treated diesel and heavy gas oils from the existing delayed coker unit and crude unit will be sent to the proposed new Fluid Catalytic Cracking Unit (FCCU). The FCCU will convert these intermediate gas oils into lighter products, such as LPG (liquefied petroleum gas), gasoline, and diesel.

The FCCU will consist of three sections: the reactor/regenerator, the main fractionation section, and the gas concentration section. In the reactor/regenerator section, the intermediate gas oils will be “cracked” into smaller components in the presence of catalyst, and the “spent” catalyst will be stripped of coke-deposits formed during the cracking process and regenerated. After the reactor, the product stream will be sent to the main fractionation section, where the stream will be separated. “Overhead wet gas” and unstabilized gas streams will be sent to the gas concentration section, while light cycle oil will be reprocessed within the refinery.

Emissions are discussed below, along with the Best Available Control Technology determination for each PSD pollutant.

### **7.1.1. NO<sub>x</sub>**

NO<sub>x</sub> is present in the FCCU regenerator flue gas. The NO<sub>x</sub> is formed from the reaction of nitrogen with oxygen when the spent catalyst is regenerated. After steam-stripping hydrocarbons, the catalyst is sent to the regenerator where hot air is blown through the catalyst, burning off coke carbon and sulfur deposits.

The applicant has identified the following as possible technologies for the control of NO<sub>x</sub> from the FCCU; all have been identified as being technologically feasible.

- Inherently low NO<sub>x</sub> regenerator design
- Selective Catalytic Reduction (SCR)
- Low Temperature Oxidation (LoTOx)
- Selective Non-Catalytic Reduction (SNCR)
- NO<sub>x</sub> reducing catalyst additives and low NO<sub>x</sub> combustion promoters

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

The Applicant has proposed as BACT for NO<sub>x</sub> an emission limit of 20 ppmvd (365-day rolling average), corrected to 0% oxygen, except during startups and shutdowns. The Applicant has proposed to achieve these limits through an inherently low- NO<sub>x</sub> regenerator design (full-burn unit), coupled with SCR controls. The Applicant has stated that it cannot achieve the 20 ppmvd NO<sub>x</sub> limit during periods of startup and shutdown because the equipment cannot be maintained at optimal operating conditions during these periods. Most importantly, temperature within the SCR catalyst cannot be maintained to achieve NO<sub>x</sub> reduction efficiencies during startup. BACT for startup and shutdown periods is discussed in section 7.1.5.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent NO<sub>x</sub> permit limits for FCCUs. As shown below, the ExxonMobil Torrance Refinery permit includes an additional emission limit with a shorter averaging period of 40 ppm over a 7 day averaging period.

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	20 ppm (365 day)	SCR + inherently low-NO <sub>x</sub> regenerator design	Application	Estimated emissions: 16.8 lb/hr 36.9 tpy
ExxonMobil (Torrance Refinery)	2007	20 ppm (365 day) 40 ppm (7 day)	SCR	RBLC	
Valero (New Orleans)	2007	144.89 lb/hr 191.78 tpy 20 ppm (365 day)	No controls specified	RBLC	

Therefore, based on other similar, recently permitted operations EPA concludes that the emission level proposed by Big West, in conjunction with an additional emission limit of 40 ppmvd (7-day rolling average), corrected to 0% oxygen, for periods other than startup and shutdown, is the most stringent level of control and therefore represents BACT for the FCCU; no other analysis is needed since the most stringent control option was chosen.

### **7.1.2. CO**

CO is also present in the FCCU regenerator flue gas. As noted above, “spent” catalyst is sent to the regenerator where hot air is blown through the catalyst to burn off coke carbon and sulfur deposits. FCCU regenerators can operate in one of two modes: full burn or partial burn. A

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

partial burn unit will convert the coke deposits to CO and CO<sub>2</sub>. A full burn unit, when properly designed and operated, will convert nearly all of the coke to CO<sub>2</sub>, thereby limiting CO emissions. The Big West CFP FCCU will operate in full burn mode.

The applicant has identified the following as possible technologies for the control of CO from the FCCU.

- Good combustion practices
- Catalytic Oxidation

Catalytic oxidation was eliminated as a control option due to technical infeasibility, due to insufficient temperatures for the oxidation reaction to take place, and possible catalyst fouling due to particulate matter present in the exhaust stream.

The Applicant has proposed good combustion practices as BACT for CO control for the proposed FCCU, resulting in limits of 78 ppmvd (rolling 30-day average), corrected to 0% oxygen, and 59 ppmvd (rolling 365-day average), corrected to 0% oxygen, except during periods of startup and shutdown. BACT for startup and shutdown periods is discussed in section 7.1.4. As noted above, full-burn combustion technology, if properly designed and operated, will ensure nearly complete oxidation of CO to CO<sub>2</sub> in the regenerator exhaust. A CO boiler or afterburner is not necessary as in the case of partial-burn units.

Subsequent to the Applicant's submittal of its latest application (dated December 2006), the Applicant also proposed another emission limit of 500 ppmv (1-hour average), corrected to 0% oxygen

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent CO permit limits for FCCUs.

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	78 ppm (30-day) 59 ppm (365-day) 500 ppm (1-hr)	Full burn technology and good combustion practices	Application	Estimated emissions: 128 (lb/hr) 66 (tpy)
Valero Ardmore	2007	50 ppm (365-day)	High Temperature Regeneration (partial burn unit)	RBLC	
Sunoco	2006	100 ppm (365-day) 500 ppm (1-hr)	CO Boiler	RBLC	

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

As shown in the table above, a lower limit based on a 365-day averaging period has been proposed since Big West submitted a revised application in December 2006. Therefore, the most stringent limit known to EPA is 50 ppm (365-day) in combination with a 78 ppm (30-day) limit and a 500 ppm (1-hr) limit. These limits can be achieved with the chosen technology, except during periods of startup and shutdown. Therefore, EPA concludes that this combination of limits represents BACT for the FCCU.

### **7.1.3. SO<sub>2</sub>**

Like NO<sub>x</sub> and CO, SO<sub>2</sub> is also present in the FCCU regenerator flue gas, from the burn-off of sulfur deposits on spent catalyst. The applicant has identified the following as possible options for the control of SO<sub>2</sub> from the FCCU.

- Control of sulfur in the FCCU feed
- SO<sub>2</sub>-reducing FCCU catalyst additives
- Wet gas scrubber

The Applicant has proposed, as BACT for SO<sub>2</sub>, emission limits of 20 ppmvd (365-day rolling average) and 50 ppmvd (7-day rolling average), each corrected to 0% oxygen, except during periods of startup and shutdown. The Applicant has proposed to achieve these levels through a combination of hydrotreating the FCCU feed to reduce sulfur levels and the use of SO<sub>2</sub>-reducing catalyst additives. Hydrotreating is a process that involves reacting hydrogen with sulfur at a high pressure and high temperature to remove sulfur from the FCCU feed before it ever reaches the FCCU. The SO<sub>2</sub> emission limits will not apply during periods of startup and shutdown, as exhaust gas temperatures may not be sufficient to allow the SO<sub>2</sub>-reducing catalyst to provide effective control. BACT for startup and shutdown periods is discussed in section 7.1.5.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent SO<sub>2</sub> permit limits for FCCUs.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	20 ppm (365-day) 50 ppm (7-day)	Hydrotreating fuel and SO <sub>2</sub> -reducing catalyst	Application	Estimated emissions: 29.3 lb/hr 51.33 tpy
Tesoro Mandan	2007	10 ppm (365-day) 18 ppm (7-day)	Wet gas scrubber	RBLC	
Marathon Ashland	2007	20 ppm (365-day) 50 ppm (7-day)	Wet gas scrubber	RBLC	
Chevron El Segundo	2007	25 ppm (365-day) 50 ppm (7-day)	Low sulfur feed	RBLC	
ConocoPhillips Billings	2007	25 ppm (365-day) 50 ppm (7-day)	SO <sub>2</sub> -reducing catalyst	RBLC	

EPA is only aware of one other FCCU permitted with more stringent emission limitations than those proposed by Big West, and that is the FCCU at the Tesoro Mandan refinery in North Dakota. These limits are being imposed as a result of EPA's Global Refinery Consent Decree Initiative and are to be achieved using an existing wet scrubber. At the time of drafting this statement of basis, testing had not been completed to determine if the new permit limit is being achieved. A wet gas scrubber has been rejected by the applicant because the use of such a system is incompatible with the particulate filters that will be needed to achieve LAER (Lowest Achievable Emission Rate) for PM 2.5<sup>1</sup>, and with the SCR system used to control NO<sub>x</sub>. Therefore, the most stringent control option is not achievable in this case due to environmental considerations. The next best option for this project is the use of low sulfur feed and SO<sub>2</sub>-reducing catalyst.

Therefore, EPA concludes that the emission level proposed by Big West, for periods other than startup and shutdown, is the most stringent level of control and therefore represents BACT for the FCCU.

#### **7.1.4. PM**

Filterable PM emissions from fluid catalytic cracking units are predominantly fine catalyst particles generated from the mechanical grinding of catalyst particles as the catalyst is continuously recirculated between the fluid catalytic cracking unit and the catalyst regenerator. The applicant has identified the following as possible options for the control of PM from the FCCU.

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<sup>1</sup> The particulate filter will achieve a control efficiency of >99.9%.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

- Hydrotreating feed
- Fabric Filter
- Electrostatic Precipitator (ESP)
- Wet gas scrubber
- Cyclones

Electrostatic precipitators and wet scrubbers are the predominant technologies used to control PM from FCCUs. Either of these control technologies can be designed to achieve overall PM collection efficiencies in excess of 95 percent. Fabric filters are an additional control option that can achieve collection efficiencies in excess of 99.9 percent. The Applicant has proposed, as BACT for PM, a limit of 0.3 lb PM/1000 lb of coke burned, using a combination of hydrotreating the FCCU feed to reduce sulfur and ammonia levels (which can contribute to PM emissions) and the use of a Pall fabric filter. Cyclones will be used upstream of the filter for primary separation of particulate matter from exhaust air. The Pall filter is a high efficiency particulate filter capable of handling high air flow rates. The Pall filter has an expected control efficiency of >99.9 percent.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent PM permit limits for FCCUs.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2007	0.3 lb/1000 lb of coke burned (total PM)	Hydrotreating fuel and pall filter (estimated 99.97% removal efficiency at 1.3 micron)	Application	
Lion Oil El Dorado	2005	0.5 lb/1000 lb of coke burned (3-hr)	Wet gas scrubber	RBLC	
Sunoco	2006	0.3 lb/1000lb coke burned (filterable, 365-day) 1 lb/1000lb coke burned (standardized)	Wet gas scrubber	RBLC	
Valero – St Charles	2007	74.6 lb/hr 276 tpy	Wet gas scrubber with SO <sub>2</sub> removal efficiency of 90% or reduce SO <sub>2</sub> in flue gas to <50ppm (7-day)	RBLC	
Marathon – Garyville	2006	0.3 lb/1000 lb coke burned (total PM, annual)	Wet gas scrubber	RBLC	

The most stringent limit known to EPA is 0.3 lb/1000 lb of coke burned (total particulate, 365-day average). It is likely that this PM limit would be achievable for the proposed FCCU unit at the Big West Bakersfield refinery; however, the presence of an SCR unit on the FCCU to control NO<sub>x</sub> emissions may hamper the ability of Big West to achieve the lower PM limit. This is because the ammonia emissions from the SCR unit can contribute to the overall condensable PM emissions. The FCCU at the Marathon, Garyville refinery is not equipped with SCR. In addition, issues with the test method (Method 202) used to measure the condensable portion of PM emissions have in the past led to false high reports of condensable PM emissions.

We are proposing as BACT for the FCCU the lower PM limit of 0.3 lb/1,000 lb coke burn-off. EPA is currently working on improvements to Method 202 to help address issues with false high testing results. In the meantime, we are proposing to include additional details in the permit regarding the procedures that should be followed when performing Method 202 tests.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

If, after 18 months of normal operation, the limit proves to be unachievable due to the additional condensables formed from the use of SCR, Big West may request a higher limit for the condensable portion only by applying for a permit revision and presenting relevant testing data to support such a request. Such data must demonstrate what proportion of condensable PM is attributable to the SCR system. Any subsequent revisions to the permit will be done in accordance with the applicable provisions of 40 CFR Parts 52.21 and 124.

### **7.1.5. Startup and Shutdown Conditions**

The applicant anticipates needing to shutdown the FCCU periodically for maintenance, approximately once every 2-5 years. As noted in the analyses above, the stringent BACT limits proposed for normal periods of operation cannot be met during periods of startup and shutdown, due to decreased effectiveness of pollution controls during these periods (for NO<sub>x</sub>, CO, and SO<sub>2</sub>). For PM, the Pall filter should continue to be effective, however decreased flows experienced during startup and shutdown may significantly affect the efficiency of the cyclones. Additionally, when feed circulation is outside of normal operating parameters, as happens during startups and shutdowns, one cannot determine compliance with emissions normalized to pounds of coke burned. Therefore, EPA is proposing to set alternate BACT standards for periods of startup and shutdown for these pollutants.

For periods of startup and shutdowns, the Applicant has proposed, as BACT, work practice standards in the form of a startup/shutdown plan. For control of CO emissions, the Applicant has also proposed a CO-reducing catalyst to be loaded into the regenerator of the FCCU during the startup process. For control of SO<sub>2</sub> emissions, the Applicant has also proposed the following work practice standards:

- Use of refinery fuel gas meeting BACT requirements in the start-up heater;
- Use of hydrotreated feed as torch oil.

The Applicant will submit a startup/shutdown plan which must be approved by both EPA and the District before initial startup of the heaters. The startup/shutdown plan will be maintained at the facility. To be considered as BACT, the startup/shutdown plan must include the following work practice standards, at minimum:



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

- Prior to operation of the FCCU startup air heater (as described in the bullet point below), the Main Air Blower (the air blower immediately upstream of the FCCU startup air heater) is the only device used to heat the regenerator.
- The FCCU startup air heater will be started and operated after the regenerator temperature reaches the lesser of (1) 300°F, or (2) 60°F below the Main Air Blower discharge temperature\*.
- Ammonia will be injected into the SCR once exhaust temperatures reach the minimum operating temperature of the SCR as specified by the manufacturer. The minimum operating temperature of the SCR will be confirmed as part of the SCR design process and will be considered final once the startup/shutdown plan is submitted to both agencies for approval before initial startup of the heaters.
- Loading of equilibrium catalyst, including CO-reducing catalyst, into the regenerator will not be initiated before the regenerator temperature reaches 1000°F\*.

Startup/Shutdown work practice standards will apply in lieu of the steady-state BACT limits as follows:

- The duration of the FCCU startup interval during which the source will not be subject to the steady-state NO<sub>x</sub> BACT limit for the FCCU will be limited to 8 hours.
- The duration of the FCCU startup interval during which the source will not be subject to the steady-state CO and SO<sub>2</sub> BACT limits for the FCCU will be limited to 64 hours.
- The shutdown duration time will be limited to 4 hours.

Based on the application, the 8-hour period allows time for the startup heater to heat the regenerator from approximately 300°F to approximately 615°F, at which point ammonia injection into the SCR can begin. Compliance with NO<sub>x</sub> BACT limits is expected once the SCR is fully operational. The 64-hour period is required to allow time for torch oil combustion to increase the regenerator temperature, plus time to achieve stable feed and combustion conditions.

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\* The startup/shutdown plan may contain temperatures that vary by ±10% from the 300°F and the 1000°F values.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

The above process is sequential; startup time beginning from burner ignition of the FCCU startup air heater will be no more than 72 hours in duration. The permit includes a requirement that the Permittee record and report the reasons for any startup exceeding 72 hours in duration.

The proposed work practice standards for the startup and shutdown periods are based on startup instructions provided by the equipment manufacturer and design engineers. EPA concurs that a startup/shutdown plan, submitted and approved before initial startup of the heaters; the proposed duration limits during the startup process for the source to achieve NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM steady-state BACT emission limits; and the proposed shutdown duration limits represent BACT during startup and shutdown periods. The startup/shutdown plans and duration limits will be applicable requirements of the PSD permit. Note that we are not aware of other refinery permits setting BACT limits for startups and shutdowns.

## **7.2. SWAATS Unit**

The proposed new FCCU and VGO-HDS units will produce streams of sour water. Water and steam come into contact with sulfur-containing gas and oils in these units, and can absorb the sulfur. This sulfur-laden water and steam is called “sour water.” The sour water is stripped of sulfur before being drained into the wastewater system. This sour water stripper gas is rich in sulfur and ammonia.

Typically, refineries use this feed in a Claus sulfur recovery process, where H<sub>2</sub>S is converted to liquid elemental sulfur, and shipped offsite and sold. The CFP will be using an alternate process, converting this feed (containing H<sub>2</sub>S, SO<sub>2</sub>, and ammonia) to a marketable liquid fertilizer product (ammonium thiosulfate solution, or “ATS”) using a Sour Water Ammonia to Ammonium ThioSulfate (SWAATS) process. The SWAATS unit will consist of two sour water stripper gas absorbers, an H<sub>2</sub>S oxidation process, an SO<sub>2</sub> absorber, and a wet scrubber. Because the end product from an ATS plant differs from the end product of a Claus plant, the SWAATS unit is not considered in the same class and category of source as a Claus plant.

Emissions from the SWAATS unit are discussed below, along with the Best Available Control Technology determination for each PSD pollutant. It should be noted that the Applicant conducted a review of the EPA RBLC and local California databases and found no entries pertaining to

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

ammonium thiosulfate production units, with one exception. The Applicant found one entry in the BACT database for the South Coast Air Quality Management District, but it addressed BACT only for PM<sub>10</sub> emissions.

The Applicant also conducted its own survey of existing ammonium thiosulfate plants and found that none of these plants used the SWAATS process, which is a recently patented process from Thiosolv. The first commercial unit is currently under construction. The SWAATS process involves the use of sour water as a feed, which has the potential to introduce hydrocarbon into the process. In contrast, the surveyed ammonium thiosulfate plants use feed materials such as elemental sulfur and purchased aqueous ammonia.

Because BACT analyses for the SWAATS process are not available, we are comparing the proposed BACT limits to the limits for other ATS plants, identified during the applicant's survey of existing plants.

#### **7.2.1. NO<sub>x</sub>**

The oxidation of H<sub>2</sub>S occurs in two stages within the SWAATS process. The first stage is the reaction burner. The entire first stage of this process is conducted in a reducing environment. Because the formation of NO<sub>x</sub> is an oxidative process, no NO<sub>x</sub> is expected to form during this stage. The second stage is a catalytic oxidation process, which takes place at temperatures far too low for the formation of thermal NO<sub>x</sub>. Based on these design aspects, NO<sub>x</sub> emissions are not expected to be formed during, or emitted from, the SWAATS process. Therefore, a BACT analysis is not required.

#### **7.2.2. CO**

Hydrocarbon will be present in the sour water stripper gas that gets fed into the SWAATS unit. Some of the hydrocarbon will be stripped out in the SO<sub>2</sub> absorption section; the rest will be combusted in the SWAATS combustor/catalytic reactor during the H<sub>2</sub>S oxidation process. Most of the hydrocarbon will be completely oxidized to CO<sub>2</sub>, but some will be left as CO.

As noted above, the Applicant's review of the EPA RBLC database and local California BACT databases did not yield any information pertaining

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

to CO emissions at ammonium thiosulfate plants. Of the 16 ATS facilities identified in the Applicant's survey, only one, Jupiter Sulphur, LLC at the ConocoPhillips Billings Montana refinery, specified limits for CO. None specified control technologies. However, through technology transfer and the examination of the source of CO in this CFP system, the Applicant proposed the following possible control technologies:

- Incineration of SO<sub>2</sub> scrubber exhaust
- Catalytic oxidation
- 3-phase separator for sour water
- Efficient combustion in the SWAATS unit

The Applicant ruled out incineration of SO<sub>2</sub> scrubber exhaust gas due to a number of factors including environmental impacts (causes an increase in NO<sub>x</sub> emissions and other combustion products). The Applicant ruled out catalytic oxidation because the required temperature of 700° to 1000°F is higher than the temperatures of the SWAATS vent gas, which is expected to be only 130°F.

The Applicant has proposed as BACT for CO an emission limit of 100 ppmvd (3-hour average) by use of a 3-phase separator upstream of the SWAATS unit to treat the sour water stream, in combination with good combustion practices. The 3-phase separator will minimize CO emissions by reducing the amount of hydrocarbons, which would otherwise be converted to CO, introduced into the SWAATS unit. Good combustion practices will improve combustion efficiency, ensuring more complete oxidation of hydrocarbons to CO<sub>2</sub>, with resultant decreases in CO.

As noted above, of the 16 ATS facilities identified during the Applicant's survey, only one, Jupiter Sulphur, LLC at the ConocoPhillips Billings Montana refinery, specified limits for CO. This limit is expressed as 1.76 tpy, and 0.4 lb/hr. The proposed BACT limit for the CFP of 100 ppm equates to a limit of 2.7 lb/hr and 11.76 tpy. According to the equipment manufacturer and the Applicant, however, the lower limits imposed on the Jupiter Sulphur ATS plant are not technically feasible for a refinery. ATS plants use a pure ammonia feed, while Big West will be using the ammonia present in the sour water stream as a feed, as a means to control sulfur. Because of the presence of hydrocarbon in the feed stream, CO emissions will be higher than if a pure ammonia stream were used.

Based on the above information, EPA concludes that the emission level

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

proposed by Big West is the most stringent level of control achievable for a SWAATS plant and therefore represents BACT for the SWAATS unit.

### **7.2.3. SO<sub>2</sub>**

The SWAATS unit is inherently an SO<sub>2</sub> control technology in that it facilitates the reaction of H<sub>2</sub>S to SO<sub>2</sub> under conditions designed to prevent formation of SO<sub>3</sub>, then captures SO<sub>2</sub> as a reactant from the resulting gas stream. The only SO<sub>x</sub> control technology the Applicant was able to identify in a review of existing ammonium thiosulfate production facilities was a scrubber. The proposed SWAATS unit includes a wet scrubber as part of its process.

The Applicant has proposed, as BACT for SO<sub>2</sub>, an emission limit of 30 ppmv (3-hour average), corrected to 0% oxygen, from the SWAATS unit.

The SWAATS will be operated in lieu of a conventional Claus sulfur recovery system and tail gas treatment unit. The Applicant's review of the RBLC for conventional Claus and tail gas treatment units shows that the SWAATS system is the more effective control technology. The Applicant found, for conventional Claus and tail gas treatment units, a maximum required sulfur recovery efficiency of 99.8% and the lowest SO<sub>2</sub> limit of 60 ppmv SO<sub>2</sub> at 0% oxygen. The Applicant's proposed SWAATS system has a vendor-guaranteed sulfur recovery efficiency of 99.9% and SO<sub>2</sub> emission level of 30 ppmv at 0% oxygen.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent SO<sub>2</sub> permit limits for Claus sulfur recovery plants, as well as to the limits identified for other ATS plants.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	30 ppm (3-hr) (=99.9% removal efficiency)	Wet scrubbing	Application	Estimated emissions: 1.8 lb/hr 8 tpy
Valero – St Charles	2007	115 lb/hr	Thermal oxidizer - Comply with NSPS J	RBLC	Sulfur Recovery Unit
Marathon – Garyville	2006	93.41 ppm	Thermal oxidizers	RBLC	Sulfur Recovery Unit
Sunoco – Toledo	2006	250 ppm (12-hr)	SRU with tail gas treatment units and incinerator	RBLC	Sulfur Recovery Unit
Poole Chemical	NA	1.84 lb/hr 8 tpy	Scrubber	Applicant Survey	ATS Plant
Jupiter Sulphur, LLC – Ponca City	NA	99.5% removal efficiency	Assumed scrubber	Applicant Survey	ATS Plant
Jupiter Sulphur, LLC - Billings	NA	167 ppm (12-hr) 25 lb/hr	Assumed scrubber	Applicant Survey	ATS Plant

Based on the above information, EPA concludes that the emission level proposed by Big West is the most stringent level of control and therefore represents BACT for the SWAATS unit.

#### **7.2.4. PM**

The final step of the SWAATS process includes an extensive water wash. These water washes effectively knock out all of the particulate matter. Because PM emissions are not expected to be formed during, or emitted from, the SWAATS process, a BACT analysis is not required.

### **7.3. Process Heaters**

The following proposed new process heaters at the refinery are subject to BACT requirements for NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM emissions: an Alky unit isostripper reboiler – rated at 215 MMBtu/hr, an HGU2 furnace - rated at 641 MMBtu/hr, and two VGO-HDS process heaters - rated at 47 MMBtu/hr and 35 MMBtu/hr.

#### **7.3.1. NO<sub>x</sub>**

NO<sub>x</sub> is formed during the combustion of fossil fuels, including natural gas and refinery fuel gas, and is generally classified as either thermal NO<sub>x</sub> or

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

fuel NO<sub>x</sub>. Thermal NO<sub>x</sub> is formed when elemental nitrogen reacts with oxygen in the combustion air within the high temperature environment of the heater burners. Fuel NO<sub>x</sub> is generated when nitrogen contained in the fuel itself is oxidized. NO<sub>x</sub> emissions can be reduced using the following controls:

- Selective Catalytic Reduction (SCR)
- Selective Non-Catalytic Reduction (SNCR)
- Combustion Controls (Low NO<sub>x</sub> Burners)
- Flue Gas Recirculation
- Steam Injection
- Good Combustion Practice

The most effective level of control can be achieved using a combination of SCR and Low NO<sub>x</sub> burners.

**7.3.1.a. Large Heaters (>50 MMBtu/hr)**

For the two larger heaters, the Applicant has proposed low- NO<sub>x</sub> burners with selective catalytic reduction (SCR) technology. This combination of controls is capable of achieving a NO<sub>x</sub> concentration of 5.0 ppmvd or less on a 15-minute average, corrected to 3% oxygen, except during periods of startup and shutdown. BACT for periods of startup and shutdown are discussed in section 7.3.4.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent NO<sub>x</sub> permit limits for large heaters fired on refinery fuel gas.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	5 ppm (15-min)	SCR + Low-NO <sub>x</sub> burners	Application	Estimated emissions (based on 641 MMBtu heater): 0.006 lb/MMBtu 3.9 lb/hr 17 tpy
ConocoPhillips – Borger	2006	0.02 lb/MMBtu	SCR + Low-NO <sub>x</sub>	RBLC	
Arizona Clean Fuels	2005	0.0125 lb/MMBtu	SCR + Low-NO <sub>x</sub> burners	ADEQ Website	
Chevron El Segundo	2004	5 ppm (3-hr)	SCR + Low-NO <sub>x</sub> burners	SCAQMD Website	

Based on the above information, EPA concludes that the emission level proposed by Big West is the most stringent level of control and therefore represents BACT for the larger process heaters during periods of normal operation.

#### **7.3.1.b. Small Heaters (≤50 MMBtu/hr)**

For the two smaller VGO-HDS heaters, the Applicant has proposed ultra-low- NO<sub>x</sub> burners alone, which will achieve a NO<sub>x</sub> exhaust concentration of 20.0 ppmvd or less (3-hour average), corrected to 3 percent oxygen, excluding startups and shutdowns. BACT for periods of startup and shutdown are discussed in section 7.3.4. The Applicant ruled out the use of post-combustion controls (i.e. SCR) based on economic impacts (in this case the use of SCR would cost >\$39,000/ton of NO<sub>x</sub> removed).

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent NO<sub>x</sub> permit limits for small heaters fired on refinery fuel gas.



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	20 ppm (3-hr)	Ultra-low-NO <sub>x</sub> burners	Application	Estimated emissions: 35 MMBtu heater: 0.024 lb/MMBtu 50MMBtu heater: 0.03 lb/MMBtu
Valero – St Charles	2007	0.04 lb/MMBtu	Ultra-low-NO <sub>x</sub> burners	RBLC	
Marathon – Garyville	2006	0.03 lb/MMBtu	Ultra-low-NO <sub>x</sub> burners	RBLC	
Arizona Clean Fuels – Yuma	2005	0.025-0.035 lb/MMBtu	Low-NO <sub>x</sub> burners	ADEQ Website	Range for different heaters 0.025-0.035 lb/MMBtu

Based on the above information, EPA concludes that the emission level proposed by Big West is the most stringent level of control required for other similar units and therefore represents BACT for the smaller process heaters during periods of normal operation.

### **7.3.2. CO**

Carbon Monoxide is formed as a result of incomplete combustion. The following control techniques have been identified for the potential control of CO emissions:

- Good combustion technique
- Catalytic Oxidation

Control of CO can be accomplished by using good combustion practice, including providing adequate fuel residence time, excess oxygen and high temperature in the combustion zone to ensure complete combustion. It should be noted, however, that these control factors also tend to result in increased emissions of NO<sub>x</sub>. Conversely, a low NO<sub>x</sub> emission rate achieved through combustion modification techniques such as Low- NO<sub>x</sub> burners can result in high levels of CO formation.

Control of CO could theoretically be achieved by the use of a catalytic oxidation system; however we are not aware of any situation in which

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

catalytic oxidation has been used to control emissions from refinery process heaters. While catalytic oxidation has been used successfully to control CO emissions from natural gas-fired turbine combustion units, the temperature of the exhaust gas from a refinery process heater is significantly lower than the temperature of the exhaust gas from a gas turbine. The effective temperature range for CO oxidation is between 600 °F and about 1000 °F. The exhaust gas from the heaters will range from 370-640 °F, depending on the heater. Because the temperatures will be under or on the very low end of the effective range, we anticipate that catalytic oxidation would not appreciably affect the emissions from the heaters. We therefore consider the application of catalytic oxidation to these heaters to be technically infeasible. For the control of both the larger and the smaller heaters, the applicant has proposed to achieve BACT limits through good combustion practices and engineering design and the use of clean-burning fuel.

**7.3.2.a. Large Heaters (>50 MMBtu/hr)**

For the two larger heaters, the Applicant has proposed, as BACT for CO, an emission limit of 10 ppmvd (3-hour average), corrected to 3% oxygen, except during periods of startup and shutdown. BACT for periods of startup and shutdown are discussed below.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent CO permit limits for large heaters fired on refinery fuel gas.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	10 ppm (3-hr)	Good combustion techniques + clean burning fuel	Application	Estimated emissions: (based on 641 MMBtu heater): 0.007 lb/MMBtu 4.7 lb/hr 20.76 tpy
Chevron Pascagoula	2007	50 ppm (12-month)	NA	RBLC	
ConocoPhillips – Borger	2006	100 ppm	Good combustion practices	RBLC	
Arizona Clean Fuels	2005	0.016 lb/MMBtu (3-hr)	Good combustion practices	ADEQ Website	
Chevron El Segundo	2004	10 ppm (3-hr)	Good combustion practices	SCAQMD Website	

Based on the above information, EPA concludes that the emission level proposed by Big West is the most stringent level of control and therefore represents BACT for the larger process heaters during periods of normal operation.

### **7.3.2.b. Small Heaters (≤50 MMBtu/hr)**

For the two smaller VGO-HDS heaters, the Applicant has proposed, as BACT for CO, an emission limit of 50 ppmvd (3-hour average), corrected to 3% oxygen, except during periods of startup and shutdown. BACT for periods of startup and shutdown are discussed below.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent CO permit limits for small heaters fired on refinery fuel gas.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	50 ppm (3-hr)	Good combustion techniques + clean burning fuel	Application	Estimated emissions (based on larger of 2 heaters): 0.037 lb/MMBtu
Valero – St Charles	2007	0.08 lb/MMBtu (1-hr)	Good combustion techniques	RBLC	
Marathon – Garyville	2006	0.03 lb/MMBtu	Good combustion techniques	RBLC	
Arizona Clean Fuels – Yuma	2005	0.04 lb/MMBtu (3-hr)	Good combustion techniques	ADEQ Website	

Based on the above information, EPA concludes that the emission level proposed by Big West is the most stringent level of control required for other similar units and therefore represents BACT for the smaller process heaters during periods of normal operation.

### **7.3.3. SO<sub>2</sub>**

SO<sub>2</sub> is formed from combustion of sulfur in the fuel gas. The amount of SO<sub>2</sub> produced is directly dependent on the amount of sulfur in the fuel. Fuel gas generated at the refinery can be treated to remove sulfur (in the form of hydrogen sulfide) before it is combusted. Refinery fuel gas amine treatment systems are capable of removing 98+% of the hydrogen sulfide.

Only one control method is in use to control SO<sub>2</sub> emissions from combustion units that are fired exclusively on refinery fuel gas: to limit the sulfur content of the fuel. A limit on the total reduced sulfur content is more stringent than a limit just on H<sub>2</sub>S since the other sulfur species (e.g., carbon disulfide, mercaptan, etc.) remain uncontrolled and may comprise a significant source of sulfur in refinery fuel gas streams.

In its revised application of December, 2006, the Applicant proposed limiting the total reduced sulfur content of the refinery fuel gas to 100 ppmv (3-hour rolling average) as BACT for SO<sub>2</sub> control for the proposed heaters. This limit was, at the time, believed to be the lowest achievable fuel gas limit for the Clean Fuels Project, based on information from the developer of the amine treatment system to be used for the CFP. However, in a letter to EPA, dated June 28, 2007, the Applicant proposed the addition of a caustic scrubber to the amine treatment system to allow the CFP to achieve a lower level of sulfur in the fuel gas system. Based on this

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

design improvement, the Applicant has proposed a BACT limit of 40 ppmv total sulfur (as H<sub>2</sub>S, on a 4-hr average) for the refinery fuel gas.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent limits for refinery fuel gas at other refineries.

Facility	Year	Limit	Control Technique	Source	Notes
Big West CFP	2006	40 ppm (4-hr, total sulfur, as H <sub>2</sub> S)	Sulfur treatment	Addendum to Application	
Valero – St Charles	2007	100 ppm (H <sub>2</sub> S, annual)	Sulfur treatment	RBLC	
Marathon – Garyville	2006	25 ppm (annual, as H <sub>2</sub> S)	Sulfur treatment	RBLC	
Arizona Clean Fuels – Yuma	2005	35 ppm (daily average)	Sulfur treatment	ADEQ Website	
Chevron El Segundo	2004	40 ppm (as H <sub>2</sub> S)	NA	SCAQMD Website	

The permit for Arizona Clean Fuels was issued in 2004 for the construction of a brand new refinery in Yuma, AZ. The facility has not yet been constructed. The Applicant does not consider this fuel gas H<sub>2</sub>S level to be achievable based on the expected pressures of the incoming streams. It should be noted, however, that the 40 ppm limit proposed by the Applicant has a shorter, more stringent, averaging period than the 35 ppm limit for Arizona Clean Fuels, which has a daily average.

The permit for the Marathon, Garyville refinery contains an annual limit on H<sub>2</sub>S concentration in the fuel gas of 25 ppm. This limit is technically feasible for the CFP, and Big West has confirmed in an application update, dated September 24, 2007, that this limit can be achieved for the CFP.

Based on the above information, EPA concludes that the fuel gas sulfur limit proposed by Big West, combined with an additional annual limit of 25 ppm H<sub>2</sub>S, is the most stringent level of control achievable and therefore represents BACT.

#### **7.3.4. PM**

Particulate matter formation from the combustion of refinery fuel gas is related to the sulfur content of fuel. The following control techniques have been identified for the potential control of PM emissions:

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

- Good combustion technique
- Limiting the sulfur content of the fuel gas

The applicant has proposed as BACT a sulfur fuel gas limit of 40 ppm (4-hr) and 25 ppm (annual). See the BACT analysis for SO<sub>2</sub> above. The applicant did not propose a separate limit for PM.

The table below compares the BACT limit proposed by Big West with examples of the most recent and stringent limits for other refinery fuel gas heaters.

Facility	Year	Limit	Control Technique	Source	Notes
Big West CFP	2006	40 ppm (4-hr, total sulfur, as H <sub>2</sub> S)	Sulfur treatment	Addendum to Application	
Valero – St Charles	2007	0.0074 lb/MMBTU (annual)	Equipment design, good combustion, and use of gaseous fuels	RBLC	
Marathon – Garyville	2006	0.0075 lb/MMBTU (annual)	Proper design, operation, and good engineering practice	RBLC	
Arizona Clean Fuels – Yuma	2005	0.0075 lb/MMBTU (3-hr)	Good combustion practices	RBLC/ADEQ Website	

In addition to limiting the sulfur content of the fuel gas, we are proposing as BACT for the process heaters a limit of 0.0074 lb/MMBtu on an annual basis. We believe this is the most stringent level of control achievable.

### **7.3.5. Startup and Shutdown Conditions**

For periods of startup and shutdown, the Applicant has proposed, as BACT, work practice standards in the form of a startup/shutdown plan. The Applicant will submit a startup/shutdown plan which must be approved by both EPA and the District before initial startup of the heaters. The startup/shutdown plan will be maintained at the facility.

To be considered as BACT, the startup/shutdown plan for the two larger heaters must include the following work practice standard, at minimum: ammonia will be injected into the SCR once exhaust temperatures reach the minimum operating temperature of the SCR as specified by the manufacturer, which is not to exceed 615°F. And the SCR must be in operation. This minimum operating temperature will be confirmed as part

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

of the SCR design process and will be considered final once the startup/shutdown plan is submitted to both agencies for approval before initial startup of the heaters.

The applicant has proposed the following limits on startup and shutdown duration:

<b>Heater</b>	<b>Startup Duration (hrs)</b>	<b>Shutdown Duration (hrs)</b>
Alky unit heater (E/U 02)	4	4
HGU2 heater (E/U 03)	16	4
VGO-HDS heaters (E/Us 04 & 05)	4	4

EPA concurs that a startup/shutdown plan, submitted and approved before initial startup of the heaters, along with the proposed startup and shutdown duration limits, represent BACT during startup and shutdown periods. Note that we are not aware of other refinery permits setting BACT limits for startups and shutdowns.

#### **7.4. FCCU Startup Air Heater**

The FCCU startup air heater will only be operated during the startup process of the FCCU. The Applicant has proposed an operational limit of 120 hours per year on this unit. This heater vents through the FCCU regenerator stack, which is equipped with SCR. Because the heater vents through the FCCU, the emissions from the startup heater alone cannot be directly measured through a source test. Startup and shutdown duration limits will be established for the entire FCCU process as a whole. Note that we are not aware of other refinery permits setting BACT limits for startups and shutdowns. Air pollutants are formed in the same manner as for the process heaters – refer to section above for an explanation of pollutant formation.

##### **7.4.1. NO<sub>x</sub>**

The Applicant has proposed a low- NO<sub>x</sub> burner and work practice standards in the form of a startup/shutdown plan as BACT. The Applicant will submit a startup/shutdown plan for the entire FCCU process (see

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

section 7.1.4. above) which must be approved by both EPA and the District before initial startup of the FCCU. EPA concurs that a startup/shutdown plan, submitted and approved before initial startup of the FCCU, along with the proposed startup and shutdown duration limits for the FCCU, represent BACT during startup and shutdown periods.

#### **7.4.2. CO**

The Applicant has proposed, as BACT for CO, an emission limit of 50 ppmvd (3-hour average), corrected to 3% oxygen, and work practice standards in the form of a startup/shutdown plan as BACT. The Applicant proposed to achieve the above limit through good combustion practices and engineering design and use of clean-burning fuel.

Since emissions from the FCCU startup air heater alone cannot be directly measured anyway, the proposed emission limit is not practicably enforceable. However, EPA concurs that good combustion practices, good engineering design, and use of clean-burning fuel to minimize emissions during startup and shutdown represent BACT during startup and shutdown periods. In addition, EPA concurs that a startup/shutdown plan, submitted and approved before initial startup of the FCCU, along with the proposed startup and shutdown duration limits for the FCCU, represent BACT during startup and shutdown periods.

#### **7.4.3. SO<sub>2</sub>**

Refer to Section 7.3.3. above.

#### **7.4.4. PM**

The Applicant has proposed, as BACT for PM, work practice standards in the form of a startup/shutdown plan as BACT. The Applicant proposes to use good combustion practices and engineering design and use of clean-burning fuel.

Since emissions from the FCCU startup air heater alone cannot be directly measured, EPA concurs that good combustion practices, good engineering design, and use of clean-burning fuel to minimize emissions during startup and shutdown represent BACT during startup and shutdown periods. In addition, EPA concurs that a startup/shutdown plan, submitted and approved before initial startup of the FCCU, along with the proposed



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

startup and shutdown duration limits for the FCCU, represent BACT during startup and shutdown periods.

## **7.5. Multipoint Ground Flare**

The CFP will include a ground level, multipoint flare to combust gases released from the new process units due to startups, shutdowns, and emergencies. The multipoint flare can be sized to handle variable flow rates and pressures, has low thermal radiation levels, and a concealed flame. Although the flare is being installed as a control device, it will also be a source of PSD pollutants; therefore a BACT determination is required. Minimizing emissions from flares depends primarily on two factors: reducing the frequency and amount of gas flared and promoting efficient combustion. BACT for refinery flares is generally expressed as design and work practice standards rather than emission limits/rates.

In making our BACT determinations for the CFP flare, we consulted EPA's RACT/BACT/LAER Clearinghouse; because the RBLC does not contain many control options for flares, in making our BACT determination we relied heavily on flare control and monitoring rules from the South Coast Air Quality Management District, the Bay Area Air Quality Management District, and the San Joaquin Valley Air Pollution Control District; EPA's existing and proposed New Source Performance Standards for Petroleum Refineries, NSPS Subparts J and Ja; and EPA Consent Decrees.

### **7.5.1. NO<sub>x</sub>**

NO<sub>x</sub> is formed as a result of the combustion of refinery fuel gas in the flare (and natural gas from the flare pilot). NO<sub>x</sub> emissions from the flare can be best reduced by promoting efficient combustion and by minimizing the amount of gas flared.

Control options to promote efficient combustion consist of designing the flare in accordance with 40 CFR Parts 60.18 and 63.11, and using a flare designed with air or steam assisted combustion and staged combustion. The Big West flare will be designed to achieve a NO<sub>x</sub> emission rate of 0.068 lb/MMBtu, as required by San Joaquin Valley Air Pollution Control District's Rule 4311.

Options to minimize flaring include installing a flare gas recovery system

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

with adequate compressor capacity to recover routine gas vents, implementing a flare minimization plan to reduce flaring resulting from startups, shutdowns, and malfunctions, and conducting cause analyses of flaring events.

We are proposing as BACT all of the above control options, with the following exception:

40 CFR Parts 60.18 and 63.11 have maximum velocity requirements for flares. However, these requirements are only applicable if the flare is used to combust routinely released gases. These maximum velocity requirements are not achievable for the flare selected by Big West, however, the permit prohibits Big West from using the flare to combust routine gases and it is therefore expected that Big West will meet the requirements of 40 CFR Parts 60.18 and 63.11.

The multipoint ground flare was selected by Big West because it allows for the emergency flaring of a wide range of flow rates at both high and low pressures. According to Big West, it would take multiple enclosed, ground level flares and a ground level or elevated high-pressure flare to achieve the same purpose. Additionally, at least one flare manufacturer indicated that enclosed flares are expected to have higher combustion temperatures, and therefore higher NO<sub>x</sub> emissions than non-enclosed flares. For this particular operation we see the multipoint ground flare as being the environmentally superior choice.

The table below compares the BACT techniques proposed by Big West with examples of the most recent and stringent BACT determinations for refinery flares.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	NA	Flare minimization, good design, good engineering practice	Application	Estimated Emissions: 0.068 lb/MMBtu 25.75 lb/hr 0.97 tpy
Valero – St Charles	2007	25.9 lb/hr	Proper equipment design and operation, good combustion practices, and use of gaseous fuels	RBLC	
Marathon – Garyville	2006	NA	Comply with 60.18	RBLC	
Sunoco – Toledo	2006	19.34 lb/hr; 84.7 tpy	NA	RBLC	

The flare at the Sunoco, Toledo refinery is subject to a lower pound per hour limit than the estimated maximum hourly emissions from the CFP flare, however, the ton per year limit is far higher than the estimated annual emissions from the Big West flare. Annual emissions from the Big West flare are expected to be much lower than the annual limits for the Sunoco flare. This is due to the use of a flare gas recovery system with redundant compressor capacity, and the stringent flare minimization requirements that are being imposed by this permit.

Based on the above information, EPA concludes that the control techniques identified for Big West's CFP flare are the most stringent control methods required for other similar units and that, therefore, these control methods represent BACT for the flare.

## **7.5.2. CO**

CO is formed as a result of incomplete combustion of refinery fuel gas in the flare. CO emissions from the flare can be best reduced by promoting efficient combustion and by minimizing the amount of gas flared.

Control options to promote efficient combustion consist of designing the flare in accordance with 40 CFR Parts 60.18 and 63.11, and using a flare designed with air or steam assisted combustion and staged combustion. Smokeless operation of the flare (in other words, operating the flare with no visible emissions) is key to ensuring efficient combustion, and thereby limiting CO emissions. The PSD permit will limit visible emissions as an

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

indicator of efficient combustion.

Options to minimize flaring include installing a flare gas recovery system with adequate compressor capacity to recover routine gas vents, implementing a flare minimization plan to reduce flaring resulting from startups, shutdowns, and malfunctions, and conducting cause analyses of flaring events.

We are proposing as BACT all of the above control options, with the following exception:

40 CFR Parts 60.18 and 63.11 have maximum velocity requirements for flares. However, these requirements are only applicable if the flare is used to combust routinely released gases. These maximum velocity requirements are not achievable for the flare selected by Big West, however, the permit prohibits Big West from using the flare to combust routine gases and it is therefore expected that Big West will meet the requirements of 40 CFR Parts 60.18 and 63.11.

The multipoint ground flare was selected by Big West because it allows for the emergency flaring of a wide range of flow rates at both high and low pressures. According to Big West, it would take multiple enclosed, ground level flares and a ground level or elevated high-pressure flare to achieve the same purpose. Additionally, at least one flare manufacturer indicated that enclosed flares are expected to have higher combustion temperatures, and therefore higher NO<sub>x</sub> emissions than non-enclosed flares. For this particular operation we see the multipoint ground flare as being the environmentally superior choice.

The table below compares the BACT techniques proposed by Big West with examples of the most recent and stringent BACT determinations for refinery flares.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	NA	Flare minimization, good design, good engineering practice, no visible emissions	Application	Estimated Emissions: 0.37 lb/MMBtu 140.11 lb/hr 5.28 tpy
Valero – St Charles	2007	56.1 lb/hr	Proper equipment design and operation, good combustion practices, and use of gaseous fuels	RBLC	
Marathon – Garyville	2006	NA	Comply with 60.18	RBLC	
Sunoco – Toledo	2006	16.25 lb/hr; 71.2 tpy	NA	RBLC	

As discussed for NO<sub>x</sub>, above, while the Sunoco, Toledo and Valero, St Charles permits have pound per hour limits that are lower than the maximum expected hourly emissions from the Big West flare, annual emissions from the Big West flare are expected to be much lower than the annual limits for the Sunoco and Valero flares. This is due to the use of a flare gas recovery system with redundant compressor capacity, and the stringent flare minimization requirements that are being imposed by this permit.

Based on the above information, EPA concludes that the control techniques identified above are the most stringent control methods required for other similar units and therefore these control methods represent BACT for the flare

### **7.5.3. SO<sub>2</sub>**

SO<sub>2</sub> is formed as a result of the combustion in the flare of fuel gas containing reduced sulfur compounds. SO<sub>2</sub> emissions from the flare can be best reduced by limiting the concentration of reduced sulfur compounds present in the refinery fuel gas, and by minimizing the amount of gas flared.

By treating sulfur in the fuel gas to 40 ppmv, Big West will minimize emissions of SO<sub>2</sub> during times when the flare is used. Big West will also be required to comply with the new NSPS Subpart Ja, which limits sulfur in the fuel gas to 60 ppmv on an hourly basis, and 160 ppmv on a 365-day

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

basis. However, BigWest should not trigger these additional limits since the NSPS exempts flaring due to emergencies, process upsets, and startups and shutdowns; Big West is prohibited from using the flare under such circumstances. It is expected that all fuel gas combusted in the flare will be treated to a level of 40ppm sulfur, as H<sub>2</sub>S.

Options to minimize flaring include installing a flare gas recovery system with adequate compressor capacity to recover routine gas vents, implementing a flare minimization plan to reduce flaring resulting from startups, shutdowns, and malfunctions, and conducting cause analyses of flaring events.

The table below compares the BACT techniques proposed by Big West with examples of the most recent and stringent BACT determinations for refinery flares.

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	NA	Flare minimization, good design, good engineering practice, low sulfur fuel treated to 40 ppm sulfur	Application	Estimated Emissions: 99.91 lb/hr 0.20 tpy
Valero – St Charles	2007	50 lb/hr	Use of refinery fuel gas treated to 100ppm sulfur	RBLC	
Marathon – Garyville	2006	NA	Comply with 60.18	RBLC	
Sunoco – Toledo	2006	5.33 lb/hr; 23.35 tpy	NA	RBLC	

As noted above for NO<sub>x</sub> and CO, annual emissions from the Big West flare are expected to be much lower than the emissions from the Valero and Sunoco flares. This is due to the use of a flare gas recovery system with redundant compressor capacity, and the stringent flare minimization requirements that are being imposed by this permit. Additionally, it should be noted that the fuel gas sulfur level will be lower, at 40 ppmv total sulfur (4-hr) and 25 ppm H<sub>2</sub>S (annual), thereby reducing SO<sub>2</sub> emissions when gas is combusted.

Based on the above information, EPA concludes that the control techniques identified above are the most stringent control methods required for other similar units and therefore these control methods represent BACT for the flare.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

#### **7.5.4. PM**

PM is formed as a result of incomplete combustion of refinery fuel gas in the flare. PM emissions from the flare can be best reduced by promoting efficient combustion and by minimizing the amount of gas flared.

Control options to promote efficient combustion consist of designing the flare in accordance with 40 CFR Parts 60.18 and 63.11, and using a flare designed with air or steam assisted combustion and staged combustion. Smokeless operation of the flare (in other words, operating the flare with no visible emissions) is key to ensuring efficient combustion, and thereby limiting PM emissions. The PSD permit will limit visible emissions as an indicator of efficient combustion.

Options to minimize flaring include installing a flare gas recovery system with adequate compressor capacity to recover routine gas vents, implementing a flare minimization plan to reduce flaring resulting from startups, shutdowns, and malfunctions, and conducting cause analyses of flaring events.

We are proposing as BACT all of the above control options, with the following exception:

40 CFR Parts 60.18 and 63.11 have maximum velocity requirements for flares. However, these requirements are only applicable if the flare is used to combust routinely released gases. These maximum velocity requirements are not achievable for the flare selected by Big West, however, the permit prohibits Big West from using the flare to combust routine gases and it is therefore expected that Big West will meet the requirements of 40 CFR Parts 60.18 and 63.11.

The multipoint ground flare was selected by Big West because it allows for the emergency flaring of a wide range of flow rates at both high and low pressures. According to Big West, it would take multiple enclosed, ground level flares and a ground level or elevated high-pressure flare to achieve the same purpose. Additionally, at least one flare manufacturer indicated that enclosed flares are expected to have higher combustion temperatures, and therefore higher NO<sub>x</sub> emissions than non-enclosed flares. For this particular operation we see the multipoint ground flare as being the environmentally superior choice.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

The table below compares the BACT techniques proposed by Big West with examples of the most recent and stringent BACT determinations for refinery flares.

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2006	NA	Flare minimization, good design, good engineering practice, no visible emissions	Application	Estimated Emissions: 0.026 lb/MMBtu 9.85 lb/hr 0.37 tpy
Valero – St Charles	2007	0.33 lb/hr	Proper equipment design and operation, good combustion practices, and use of gaseous fuels	RBLC	
Sunoco – Toledo	2006	1.47 lb/hr; 6.44 tpy; 0.0074 lb/MMBTU	NA	RBLC	

As discussed for NO<sub>x</sub>, CO, and SO<sub>2</sub> above, while the Sunoco, Toledo and Valero, St Charles permits have pound per hour limits that are lower than the maximum expected hourly emissions from the Big West flare, annual emissions from the Big West flare are expected to be much lower than the annual limits for the Sunoco and Valero flares. This is due to the use of a flare gas recovery system with redundant compressor capacity, and the stringent flare minimization requirements that are being imposed by this permit.

Based on the above information, EPA concludes that the control techniques identified above are the most stringent control methods required for other similar units and therefore these control methods represent BACT for the flare

## **7.6. Emergency Diesel Firewater Pump Engines**

As part of the CFP, the Applicant will install new diesel-fired emergency internal combustion engines. Combustion of diesel fuel will result in emissions of NO<sub>x</sub> and CO. SO<sub>2</sub> and PM will also be formed in small quantities. The Applicant is anticipating using two Cummins Model CFP15E-F10 engines, rated at 479 horsepower. These engines are expected to be UL-certified, Tier 3 engines. At a minimum, the engines will be Tier 2 engines and will meet the relevant California performance



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

standards for NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM. Non-emergency use will be limited to the number of hours necessary to comply with the testing requirements of the National Fire Protection Association (NFPA) 25 – “Standard for the Inspection, Testing, and Maintenance of water-based fire Protection Systems.”

The table below compares the Tier 2 standards that we are proposing as BACT with examples of the most recent and stringent limits for emergency engines. All four PSD pollutants (NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM) are covered by this table.

Facility	Year	Limit	Control Technique	Source	Notes
Big West CFP	2006	Meet Tier 2 standards at a minimum: NO <sub>x</sub> + NMHC = 4.8 g/bhp-hr CO = 2.6 g/bhp-hr SO <sub>2</sub> = 15ppm sulfur diesel PM = 0.15 g/bhp-hr	Engine design	Application	Estimated emissions (conservative based on 3 engines, 525 HP each, tier 2 emission standards: NO <sub>x</sub> = 15.42 lb/hr CO = 9.03 lb/hr SO <sub>2</sub> = 0.02 lb/hr PM = 0.52 lb/hr
Creole Trail LNG	2007	NO <sub>x</sub> = 37.95 lb/hr CO = 12.24 lb/hr SO <sub>2</sub> = NA PM = 0.64 lb/hr	Engine design and good combustion practice	RBLC	
Archer Daniels Midland – Cedar Rapids	2007	Meet Tier 2 standards	Engine design	RBLC	

Therefore, based on other similar, recently permitted operations EPA concludes that the use of Tier 2 or Tier 3 engines, in conjunction with limiting use to emergencies and testing, is the most stringent level of control and represents BACT for these emergency fire pumps.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

## **7.7. Cooling Towers**

As part of the CFP, the Applicant is proposing to install two forced-draft evaporative cooling towers. One cooling tower will provide cooling water to the shell and tube heat exchangers in the VGO-HDS unit, the FCC unit, the Merox unit, the HGU2, and various other new utility and process units. The second cooling tower will provide cooling water for the new Alky Unit. The circulation rate for each cooling tower will be 15,000 gallons per minute (gpm). There will be no emissions of NO<sub>x</sub>, CO, or SO<sub>2</sub> from the cooling towers; therefore, a BACT analysis is required for PM emissions only.

PM emissions are formed from the total dissolved solids (TDS), mostly salts, present in the cooling water. In the cooling process, some of the cooling water (and TDS) is carried away. This is referred to as drift. Some portion of the drift dries in the air before settling to the ground, with some portion of the dissolved solids becoming airborne PM. The Applicant has conservatively assumed that all drift will remain suspended in the air and will dry to PM<sub>10</sub>. This approach overestimates PM emissions. The only control option to control PM from a cooling tower itself is to install high efficiency drift eliminators that are incorporated into the cooling tower design to remove as many droplets as possible from the air stream before it exits the tower. Air cooling can be used in some applications, eliminating the need for water cooling. The applicant is proposing a high efficiency, cellular type drift eliminator designed to achieve a 0.0005% drift rate to control the amount of drift and ultimately PM that are emitted. The applicant has also incorporated air cooling into the project design wherever feasible; however water cooling is needed where a cooler temperature is required for a process unit. Of the 43 heat exchangers, 12 are air cooled.

The table below compares BACT as proposed by Big West with examples of the most recent and stringent limits for cooling towers at other refineries.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

<b>Facility</b>	<b>Year</b>	<b>Limit</b>	<b>Control Technique</b>	<b>Source</b>	<b>Notes</b>
Big West CFP	2007	No limit	High Efficiency Drift Eliminator with 0.0005% drift rate	Application amendment	Estimated emissions: (assumes 0.016% drift rate*, 2000 ppm TDS) 0.24 lb/hr 1.05 tpy
Valero – St Charles	2007	No Limit	Drift Eliminators	RBLC	
Marathon – Garyville	2006	0.0050% drift rate	High Efficiency Drift Eliminators	RBLC	
Arizona Clean Fuels – Yuma	2005	1.6 lb/hr 0.0005% drift rate	High Efficiency Drift Eliminators	RBLC/ ADEQ Website	
Sunoco – Toledo	2006	1.15 lb/hr; 5.03 tpy (75% efficiency)	Drift Eliminator	RBLC	

We are proposing as BACT a high efficiency drift eliminator with a 0.0005% drift rate. The permit will also limit total dissolved solids in the circulating water in the cooling tower to 2000 ppm. We believe that these limits are the most stringent and represent BACT for refinery cooling towers.

## **8. Air Quality Impacts**

The PSD regulations require an ambient air quality impact analysis to determine the impacts of the proposed project on ambient air quality. The main purpose of the air quality analysis is to demonstrate that new emissions from a proposed project will not cause or contribute to a violation of any applicable NAAQS or PSD increment. For all criteria pollutants emitted in significant quantities, the analysis must consider whether the proposed project will cause a violation of (1) the applicable PSD increments, and (2) the National Ambient Air Quality Standards (NAAQS). NAAQS and increment levels only exist for criteria pollutants; therefore this section primarily focuses on air quality impacts on increment consumption and NAAQS for the criteria pollutants regulated by this PSD permit (NO<sub>x</sub>, CO, and SO<sub>2</sub>). Modeled impacts from PM emissions are provided in this section as well; however there are no standards to which to compare the impacts. Ambient impacts from criteria and noncriteria pollutants

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\* The applicant originally proposed a drift eliminator with 0.016% drift rate. Emissions in the application were based on this lower efficiency, as were the air quality impacts. Calculations based on a 0.0005% drift rate yield an emission rate of 0.075 lb/hr.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

emitted in significant amounts for this project (NO<sub>x</sub>, CO, SO<sub>2</sub>, and PM) are addressed in Section 9, below.

A discussion on the general approach, existing air quality, air quality model selection, significant impact levels, de minimus monitoring levels, PSD increment consumption, and compliance with ambient air quality standards is presented below.

## **8.1. Ambient Data Requirements and Significant Impact Levels**

PSD regulations contain provisions that require an applicant to provide an ambient air quality analysis, which may include pre-application monitoring data, and in some instances post-construction monitoring data, for any pollutant proposed to be emitted in significant amounts by a new major source or major modification. If predicted ambient impacts or existing ambient pollutant concentrations are less than the significant monitoring thresholds prescribed in the PSD regulations, then an applicant may be exempted from this requirement.

Maximum annual and short-term emissions from the CFP were modeled and the resulting impacts compared with the federal pre-construction monitoring significance levels. The results of the significant impact analysis are shown in Table 8.2-1. Monitoring significance levels would be not exceeded for any pollutant, therefore pre-construction ambient air quality monitoring has not been proposed for this project.

## **8.2. Dispersion Modeling Analysis**

The air quality impacts in the Class II area surrounding the Big West refinery were determined with the most recent version of the EPA Industrial Source Complex Short-Term Model (ISCST3, version dated 02035; USEPA, 1995a). The ability of the ISCST3 model to accommodate varying source types and terrain makes it an appropriate selection for this analysis. The November 9, 2005, *Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose Dispersion model and Other Revisions; Final Rule* indicated that “beginning one year after promulgation of today’s notice, (1) applications of ISC3 with approved protocols may be accepted.” The dispersion modeling protocol for this application was submitted to the EPA and Federal Land Managers (FLM) in May 2005, and the permit application for Big West was determined to

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

be complete in April, 2006. Therefore, the use of ISC3 is acceptable for this application. The area was classified as urban, based on the Auer methodology.

EPA recognizes that nearby buildings can cause plume downwash, leading to high pollutant concentrations. The applicant used the EPA Building Profile Input Program (BPIP) adapted for use with ISCST3 to determine the direction-dependent building input parameters (version 04274) (USEPA, 1995c; USEPA, 2004). Several of the nearby structures were sufficient to cause downwash of the stack exhaust; therefore the direction specific building downwash algorithms in ISC3 were used. This program was also used to calculate the Good Engineering Practice (GEP) stack height for each source location. No project stack height exceeded the calculated GEP stack height.

Five years of surface meteorological data from the Bakersfield meadow Field Airport National Weather Service site (WBAN 23155) were used, 1999, 2000, 2002, 2003, and 2004. The year 2001 did not have adequate wind speed capture, and therefore was not used. Upper air data collected at the Oakland station (WBAN 23230) for corresponding years was used.

Maximum annual and short-term emissions from the CFP were modeled and the resulting impacts compared with the Class II significance impact levels. The results of the significant impact analysis are shown in Table 8.2-1 and indicate that the Class II significant impact levels would not be exceeded for any pollutant. Because no pollutants exceeded the significant impact levels, as shown in Table 8.2-1, the proposed project does not trigger a NAAQS analysis or an increment consumption analysis under the PSD program regulations.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

**Table 8.2-1: Maximum Project Impacts Compared with Class II Significant Impact Levels and Monitoring Significance Levels**

Pollutant	Averaging Period	Maximum Predicted Impact ( $\mu\text{g}/\text{m}^3$ )	Class II Significant Impact Level ( $\mu\text{g}/\text{m}^3$ )	Monitoring Significance Level ( $\mu\text{g}/\text{m}^3$ )
NO <sub>2</sub>	Annual	0.68	1.0	14
SO <sub>2</sub>	Annual	0.83	1.0	NA
	3-hour	10.71	25.0	NA
	24-hour	3.37	5.0	13
CO	1-hour	183.42	2,000	NA
	8-hour	31.38	500	575

Notes:

<sup>a</sup> EPA default Ambient Ratio Method factor of 0.75 applied.

NA = Not applicable/not defined

**Table 8.2-2: Maximum Project Impacts for Particulate Matter**

Pollutant	Averaging Period	Maximum Predicted Impact ( $\mu\text{g}/\text{m}^3$ )	Class II Significant Impact Level ( $\mu\text{g}/\text{m}^3$ )	Monitoring Significance Level ( $\mu\text{g}/\text{m}^3$ )
PM	Annual	0.48	NA	NA
	24-hour	1.6	NA	NA

### 8.3. Class I AQRV Impact Analysis

The Applicant has conducted a PSD impact analysis relative to Air Quality Related Values (AQRV) impacts on Class I areas located within 100 kilometers of the project location. Class I areas are national or regional areas of special natural, scenic, recreational, or historic value for which the PSD regulations provide special protection. Air quality degradation in all Class I areas is limited by Class I increments for SO<sub>2</sub>, PM<sub>10</sub>, and NO<sub>2</sub>. No specific increment exists for the impact of CO on a Class I area. The nearest Class I area is the Dome Land Wilderness Area (WA), located approximately 80 km to the northeast of the refinery. San Rafael WA is the next closest Class I area, located approximately 90 km southwest of the refinery. Sequoia National Park is located just over 100 km away, to the north of the refinery.

For these areas, proposed project sources were modeled, and impacts compared to the PSD Class I modeling significance levels as defined by

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) (see Tables 8.3-1, 8.3-2, and 8.3-3). For each Class I area, modeling was also conducted to assess the effect of the proposed project on visibility and acid deposition.

To estimate air quality impacts at the Class I areas, the applicant used the CALPUFF model, which was run in a screening mode (Tier 2 or CALPUFF-lite). The CALPUFF model is a puff-type model that can incorporate three-dimensionally varying wind fields, wet and dry deposition, and atmospheric gas and particle phase chemistry. The FLM may request a CALPUFF modeling study at its discretion; however the FLM has determined CALPUFF-lite to be adequate at this time. The modeled concentration do not exceed the applicable FLAG threshold values for maximum concentrations of NO<sub>2</sub>, PM<sub>10</sub>, and SO<sub>2</sub> in the Class I areas, (Tables 8.3-1, 8.3-2, and 8.3-3). The PM emissions for this facility are equivalent to the PM<sub>10</sub> emissions. The air quality impact for PM is, therefore, equal to the impact of PM<sub>10</sub> presented in (Tables 8.3-1, 8.3-2, and 8.3-3).

The visibility modeling predicted a small number of days in excess of the 5% FLAG threshold value for change in extinction for each of the Class I areas. (Tables 8.3-1, 8.3-2, and 8.3-3). The FLM has judged the modeled impacts to be insignificant, because the frequency of the exceedances is small (3 days per year) and the magnitude is only marginally above the 5% visibility impact threshold.

The PM emissions for this facility are equivalent to the PM<sub>10</sub> emissions. The visibility impact for PM is, therefore, equal to the visibility impact of PM<sub>10</sub> presented in (Tables 8.3-1, 8.3-2, and 8.3-3).

The visibility modeling predicted a small number of days in excess of the 5% FLAG threshold value for change in extinction for each of the Class I areas (Tables 8.3-1, 8.3-2, and 8.3-3). The FLM has judged the modeled impacts to be insignificant, because the frequency of the exceedances is small (3 days per year) and the magnitude is only marginally above the 5% visibility impact threshold.

In addition, the modeling results provided information on total nitrogen and sulfur deposition rates. (Tables 8.3-1, 8.3-2, and 8.3-3)  
These values were compared to the US National Park Service (USNPS) and US Fish and Wildlife Service (USFWS) deposition analysis thresholds

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

(DAT) for western states. The modeling results yielded a deposition value for total nitrogen that did not exceed the DAT at any of the Class I areas. The modeling results for deposition of total sulfur are marginally above the 0.005 kg/ha-year threshold value. The FLM has judged that this impact is insignificant.

**TABLE 8.3-1: CALPUFF Modeled Impacts – Dome Land**

Year of Meteorological Data	Modeled Scenario					
Concentration	NO <sub>2</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )		SO <sub>2</sub> (µg/m <sup>3</sup> )		
	Annual	24-hour	Annual	3-hour	24-hour	Annual
Max (1999-2004)	0.005	0.08	0.011	0.73	0.17	0.012
Threshold	0.1	0.3	0.2	1	0.2	0.1
Exceed?	No	No	No	No	No	No

Year of Meteorological Data	Modeled Scenario		
Visibility	Reduction (%)	Days > 5%	Days > 10%
Max(1999-2004)	6.76	16	0
Threshold	5	0	0
Exceed?	<b>Yes</b>	<b>Yes</b>	No

Year of Meteorological Data	Modeled Scenario	
Deposition	Total N (kg/ha/yr)	Total S (kg/ha/yr)
Max	0.002	0.006
Threshold	0.005	0.005
Exceed?	No	<b>Yes</b>



**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

**TABLE 8.3-2: CALPUFF Modeled Impacts - San Rafael**

Year of Meteorological Data	Modeled Scenario					
Concentration	NO <sub>2</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )		SO <sub>2</sub> (µg/m <sup>3</sup> )		
	Annual	24-hour	Annual	3-hour	24-hour	Annual
Max (1999-2004)	0.005	0.079	0.01	0.66	0.17	
Threshold	0.1	0.3	0.2	1	0.2	0.1
Exceed?	No	No	No	No	No	No

Year of Meteorological Data	Modeled Scenario		
Visibility	Reduction (%)	Days > 5%	Days > 10%
Max	6.59	12	0
Threshold	5	0	0
Exceed?	<b>Yes</b>	<b>Yes</b>	No

Year of Meteorological Data	Modeled Scenario	
Deposition	Total N (kg/ha/yr)	Total S (kg/ha/yr)
Max	0.0015	0.0052
Threshold	0.005	0.005
Exceed?	No	<b>Yes</b>

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

**TABLE 8.3-3: CALPUFF Modeled Impacts - Sequoia**

Year of Meteorological Data	Modeled Scenario					
Concentration	NO <sub>2</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )		SO <sub>2</sub> (µg/m <sup>3</sup> )		
	Annual	24-hour	Annual	3-hour	24-hour	Annual
Max (1999-2004)	0.003	0.072	0.007	0.43	0.12	0.007
Threshold	0.1	0.3	0.2	1	0.2	0.1
Exceed?	No	No	No	No	No	No

Year of Meteorological Data	Modeled Scenario		
Visibility	Reduction (%)	Days > 5%	Days > 10%
Max	6.23	2	0
Threshold	5	0	0
Exceed?	<b>Yes</b>	<b>Yes</b>	No

Year of Meteorological Data	Modeled Scenario	
Deposition	Total N (kg/ha/yr)	Total S (kg/ha/yr)
Max	0.0011	0.0035
Threshold	0.005	0.005
Exceed?	No	No

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

## **9. Additional Impact Analysis**

### **9.1. Growth Analysis**

The purpose of the growth analysis is to project the industrial, commercial, and residential growth, and related emissions, that are anticipated to occur in the area due to the construction of the new major source or modification. The emissions associated with such projected growth are those not directly related to the new source or modification.

The proposed project outlined in this application is not expected to create more than 30 new full-time positions, which will result in total employment below historic levels at the Shell Refinery (250 after CFP vs. 270 peak historic). The Bakersfield metropolitan statistical area (MSA) has a population of approximately 270,000 people (247,057 according to the 2000 census). Thus, any industrial, commercial, and residential growth associated with the proposed project will not be substantial compared to the size of the Bakersfield industrial, commercial and population base. No appreciable increase in emissions is expected because of growth associated with the proposed project. It is anticipated that hiring for the construction phase of the project would be done, primarily, from the surrounding communities, as would hiring of some of the operations personnel. Moreover, no new housing will be required to support the project. Consequently, no significant increase in air pollutant emissions indirectly associated with the proposed project is expected to occur.

### **9.2. Vegetation Analysis**

This requirement addresses the potential impact of the proposed project's emissions on sensitive soils and vegetation, of commercial or recreational value, occurring in the project's impact area. The NAAQS establish secondary standards that are intended to protect public welfare, including the consideration of economic interests, vegetation, and visibility. While ambient concentrations of criteria pollutants below the secondary NAAQS are expected to be protective of most soil types and vegetation, this may not be true for particularly sensitive soils or plant species. The potential impacts of the proposed project were compared to relevant thresholds, including but not limited to, secondary NAAQS, to determine effects on soil and vegetation.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

Table 9.2-1 presents the reported minimum exposure levels at which visible damage to or growth retardation of plants may occur. The data reflect studies that were conducted primarily on crops of commercial value.

The Applicant has conducted an analysis of the potential effects of NO<sub>2</sub>, CO, and SO<sub>2</sub> emissions on vegetation surrounding the site. Based on a comparison of maximum predicted concentrations to the respective thresholds shown in Table 9.2-1, the project's impacts are significantly below threshold screening values, and therefore will not adversely affect crops grown in the area.

Soils in the impact area, which would be affected mainly through the deposition and subsequent leaching of particulate contaminants, are not expected to be adversely affected.

**TABLE 9.2-1: Comparison of Maximum Predicted Project Concentrations with Plant Effect Screening Thresholds**

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m <sup>3</sup> )	Screening Level <sup>a</sup> (µg/m <sup>3</sup> )
NO <sub>2</sub>	Annual	0.63	94-188
	4-Hour	11.5	3,760
SO <sub>2</sub>	Annual	0.86	18
	1-Hour	16.4	917
	3-Hour	8.26	786
CO	1-Hour	42.1	1,800,000

<sup>a</sup> Level associated with most sensitive species. Based on information in the EPA document: A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals (USEPA, 1980). Concentrations reflect atmospheric conditions of 20°C and 1 atmosphere.

### **9.3. Visibility Impairment Analysis**

EPA guidance indicates that visibility impairment within the impact area of proposed new major sources or modifications should be evaluated. This is a visibility assessment for Class II areas. The EPA guidance suggests a tri-level screening procedure, in which the VISCREEN model is used as a first-level screen. Depending on the outcome of the first-level screen, the VISCREEN model may be used to conduct a second-level screen, using information more specific to the source, topography, and local meteorological conditions. If the Level 1 and the Level 2 screening

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

analyses indicate the possibility of visibility impairment, then use of a more sophisticated plume visibility model in a third-level screen is suggested.

A conservative Level 1 analysis was conducted using the EPA VISCREEN model to evaluate the visibility impacts in the Class II area surrounding the Big West refinery. The analysis is conservative given the use of very stable atmospheric dispersion coupled with a very low wind speed persisting for 12 hours and a wind direction that would transport the plume directly adjacent to the observer. Source emissions input were the maximum short-term rates for NO<sub>x</sub> and PM<sub>10</sub> for the proposed units. Model default emission rates (i.e., zero emissions) were selected for primary NO<sub>2</sub>, soot, and sulfate. A background visual range of 110 km and a background (default) ozone concentration of 0.04 ppm were used. The background visual range corresponds with that identified for the area in Figure 9 of the Workbook for Plume Visual Impact Screening and Analysis (Revised) (EPA, 1992). The actual background visual range for the area is unknown, but the value of 110 km used in this analysis is likely conservative given the agricultural and industrial activity in the area.

To assess the proposed project's impact on a scenic view in the area, the state parks located in the county were identified. The closest state park to the refinery is the Tule Elks State Reserve, which is located approximately 25 km to the west-southwest of the refinery.

The potential for plume visual impacts is directly related to the stability of the atmosphere and to the presumed background visual range. Visibility effects thresholds have not been established for Class II areas, and the Level 1 procedure automatically compares the impacts against Class I thresholds. Without plume visual impact standards for Class II areas, it is difficult to be conclusive regarding the nearby visual effect of plumes from the project. Preliminary estimates of delta E under stable atmospheric conditions slightly exceed FLAG levels of concern for Class I areas. This is not judged to be significant for a Class II area.

The PM emissions for this facility are equivalent to the PM<sub>10</sub> emissions. The visibility impact for PM is, therefore, equal to the visibility impact of PM<sub>10</sub>.

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

## **10. Endangered Species Act**

Pursuant to Section 7 of the Endangered Species Act (ESA), 16 U.S.C. 1536, and its implementing regulations at 50 C.F.R. Part 402, EPA is required to ensure that any action authorized, funded, or carried out by EPA is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of such species' designated critical habitat. EPA has determined that this PSD permitting action is subject to ESA Section 7 requirements.

For this project, the Applicant initiated contact with the U.S. Fish and Wildlife Service (USFWS) by requesting concurrence from them that the construction and operation of the Clean Fuels Project is not likely to adversely affect species protected by the ESA. This request was made after the Applicant had engaged in informal consultation with FWS for several months. In particular, the consultation focused on the potential impacts to the federally endangered San Joaquin kit fox. The Applicant prepared and submitted a biological assessment (BA) detailing the potential impacts of the project on the San Joaquin kit fox and proposing mitigation measures that it committed to implementing. Based on the information and proposed impact minimization measures provided by the Applicant, the FWS determined that the proposed project has the potential to adversely affect the kit fox. Therefore, the FWS concluded that a formal consultation pursuant to Section 7(a)(2) of the ESA is required.

EPA initiated formal consultation with the FWS on December 27, 2006. The FWS is preparing a biological opinion (BO) to address potential impacts from this project, as well as from related projects to construct a bridge over the Friant-Kern canal, and to construct four new gas liquids pipelines from Inergy Propane, LLC to the Big West Bakerfield refinery. EPA will not finalize a PSD permit allowing construction to commence for the Clean Fuels Project until a BO is issued by FWS, and until the Applicant commits to implementing any proposed mitigation measures outlined in the BO.

## **11. Conclusion and Proposed Action**

EPA is proposing to issue a PSD permit to Big West of California, LLC for the construction of the Clean Fuels Project at the existing Bakersfield refinery. We believe that the proposed project will comply with PSD requirements, including the installation and operation of equipment to achieve BACT-level emission control, and will not cause or contribute to a violation of the NAAQS, or of any PSD increment. We have made this determination based on the information

**BIG WEST OF CALIFORNIA, LLC  
BAKERSFIELD REFINERY – CLEAN FUELS PROJECT**

**Revised  
Statement of Basis and  
Ambient Air Quality Impact Report**

supplied by the applicant and our review of the analyses contained in the permit application. EPA will provide the proposed permit and this Statement of Basis and Ambient Air Quality Impact Report to the public for review, and will make a final decision after considering all public comments on our proposal.